

Digital Game-based Learning for Early Childhood Education: Understanding Ghanaian Teachers' adoption for teaching effectiveness

Prince Kelvin Owusu¹ and Prof. Irene Govender²
 Comp Sc and Information Systems and Technology
 University of KwaZulu-Natal, Durban, South Africa

Abstract

Digital Game-Based Learning (DGBL) holds a lot of promises for improving teaching and learning outcomes in Early Childhood Education (ECE). There are, however, several factors that influence teachers' motivation and capacity to use technology in the classroom. Using the Unified Theory of Acceptance and Use of Technology (UTAUT), this study examines how ECE teachers view and use DGBL in the classroom. Surveys were used as part of a quantitative research method to record the depth and breadth of teacher experiences. There were 147 participants in this study. The findings showed that while teachers acknowledge the potential of DGBL to boost students' engagement and achievement, they often encounter challenges related to the use of digital tools and the steep learning curves. The availability of infrastructure and training opportunities, as well as social factors including support from peers and school administration, were also found to be important predictors of adoption. This study offers important insights into the elements that facilitate or impede the successful integration of digital games in early learning by utilizing the UTAUT framework. It is important to consider these findings in the development of curriculum, the preparation of teachers, and policymaking.

Keywords: *Early Childhood Education, Digital Game-Based Learning, UTAUT, Teacher Adoption, Technology Integration*

1. Introduction

Ghana Education Service (GES) and the Ministry of Education's (MoE) national curriculum acknowledge the significance of the utilisation of technologies and mandate their implementation for educational purposes from nursery to university level (GES, 2021). While Ghana's education system has made significant advances in improving access to education, with increasing enrolment rates at all levels, there remain disparities among rural and urban areas, particularly with regards to resources, value of a teacher, and outcomes regarding early childhood education (ECE). Rural schools often face challenges such as inadequate infrastructure, lack of teaching materials, and inadequate technological usage (Owusu & Govender, 2026). As wealth and power are highly distorted in many countries, it creates enormous challenges for equity and quality in education, both in rural and urban areas. As a result, educational efficiency is severely affected in many rural areas (Kormos & Wisdom, 2021), thus hindering the achievement of Sustainable Development Goal (SDG) 4, equity and quality education for all (United Nations, 2015).

The rapid development and integration of digital technology have caused a dramatic upheaval in the worldwide education environment in recent decades. Traditional pedagogical methods are being re-evaluated by these developments, opening the door to more dynamic, captivating, and learner-centered training (Chen & Chang, 2024; Kucher, 2021). Digital game-based learning (DGBL), which blends structured learning objectives with the motivating appeal of games, is one of the most significant of these advancements (Behnamnia et al., 2020a). Since young children learn best via play, interaction, and experiential activities that foster cognitive, social, and emotional development, DGBL holds special promise within the field of ECE. In addition to encouraging

creativity and problem-solving skills, digital games also promote teamwork and participation, all of which are critical for early developmental milestones (Beach, 2012).

Even though DGBL is becoming more widely accepted in educational research and practice, its uptake varies depending on the setting, particularly in low- and middle-income nations like Ghana. Studies in sub-Saharan Africa show notable differences in implementation, despite data from affluent nations showing that DGBL improves literacy, numeracy, and critical thinking abilities (for example, Aguilera & de Roock, 2022; Behnamnia et al., 2020b; Aldhafeeri et al., 2016). Limited digital infrastructure, poor teacher preparation, societal views on play in the classroom, and financial limitations are some of the difficulties. The incorporation of digital tools may seem more aspirational than realistic in rural Ghana, since many schools lack basic teaching and learning resources (Owusu & Govender, 2023). However, educating children using cutting-edge pedagogical techniques is not only desirable but also essential for addressing educational disparities in a society that is becoming increasingly influenced by digital change (Kormos & Wisdom, 2021). The importance of teachers' roles in this process cannot be over-emphasised. Teachers, as the guardians of educational innovation, shape the adoption of technology approaches like DGBL through their attitudes, abilities, and preparedness (Kaimara et al., 2022). In Ghana's ECE sector, institutional support, infrastructure accessibility, and social expectations of education all have an impact on teachers' adoption of digital learning tools in addition to their own personal views (Owusu & Adjei-Boateng, 2020). To understand these dynamics, a theoretical framework that considers the various factors that influence teachers' use of technology is needed.

One such framework is provided by the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT, which was first created by Venkatesh et al. (2003), combines components from eight previous models of technology acceptance to offer an in-depth lens through which to examine user behaviour.

The implementation of DGBL in Ghana is in line with larger legislative measures and educational changes meant to enhance ECE quality and accessibility. Although play-based learning and ICT integration are prioritized in national policies, teachers' everyday experiences frequently deviate from these goals (GES, 2021). Large class numbers, poor facilities, and a lack of professional development opportunities are common challenges for teachers in rural schools, making it more difficult to use innovative teaching techniques. Teachers' digital literacy and comfort level with technology can be problematic, even in urban schools with comparatively better resources. These facts highlight the significance of determining whether DGBL can improve learning outcomes as well as whether teachers are prepared, inspired, and assisted in carrying it out successfully.

This study responds to this gap by considering the following research questions:

1. To what extent do the elements of PE, EE, SI, and FC influence ECE teachers' behavioural intentions to adopt DGBL.
2. What other factors influence the elements that affect the intention to adopt DGBL?

By focusing on the constructs of PE, EE, SI, and FC, we seek to uncover the underlying factors that encourage or hinder adoption of the DGBL approach. In an era where digital competencies are increasingly tied to educational equity and lifelong learning opportunities (Govender, 2025), understanding how teachers navigate the adoption of DGBL is critical (Akram et al., 2022). This research aims to contribute not only to academic debates on technology acceptance but also to practical efforts to support Ghanaian teachers in preparing young learners for participation in a digitally connected world.

2. Literature Review

2.1 Digital Game-Based Learning in Education

Digital games include many different types and genres that can be played on a variety of digital platforms, comprising handheld consoles, computers, and mobile devices. Quandt et al. (2015, p. 8) defined digital game as “a rule-based formal system with a changeable and quantifiable conclusion, where the player can affect the outcome, feels linked to the conclusion, and the repercussions of the action are flexible and discretionary.” DGBL is an instructional approach that employs digital games to make learning more fun and interesting (Kösa & Karakus, 2018).

When comparing traditional game-based learning to DGBL, traditional game-based learning involves the use of physical, or board games designed with educational goals in mind. These games require physical interaction and are played in person, focusing on educational objectives through tangible, non-digital means provided (Chang & Hwang, 2019). Chen (2019) maintains that while DGBL and traditional game-based learning aim to make education engaging through games, DGBL distinguishes itself by using digital technology in creating a collaborative and adaptable academic expertise. It builds on the principles of game design to enhance motivation and educational outcomes in ways that traditional physical games and broader digital learning tools might not (Kokkalia et al., 2016). Similarly, Bado (2022) states that DGBL leverages digital technology to offer complex game mechanics, instant feedback, and adaptive learning experiences that traditional games cannot offer. Digital games can adjust the complexities based on the player’s performance and incorporate multimedia elements, which enrich the learning process.

In modern education, using digital game elements in educational instruction has received much attention. There are theories underlying the claim that the educational usefulness of digital elements can increase motivation and engagement, and lead to learning (for example, Chang & Hwang, 2019; Taufik et al., 2019). Digital game elements have been investigated in a range of curriculum areas, including mathematics (Görge et al., 2020; Thompson & Gillern, 2020; Byun & Loung, 2018), science and computer science (Papadakis, 2018), social studies (Chang & Hwang, 2019), literature, and second language acquisition. These studies have examined how digital game-based elements are used in several educational settings, including universities, secondary, primary and pre-primary education with a common finding that digital game-based elements have the potential to increase student engagement and collaboration and thereby improve academic achievement.

In recent work, Nurnberger-Haag et al. (2022) underlines that the integration of digital game elements in academic activities allows students to develop a cognitive resource-based process while also learning the importance of lifetime learning and ongoing education. This could also lead to a more tailored technique and dialogue among instructors and learners. For example, Paunova-Hubenova et al. (2018) found that incorporating role-playing games into chemistry classes aided students’ learning of scientific knowledge of plastics.

2.2 Teachers adoption of the DGBL approach

Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT), which has been widely used to investigate the factors influencing technology acceptance in a variety of industries, including education. UTAUT provides a useful paradigm for comprehending how educators, caregivers, and institutions embrace educational technologies in the field of Early Childhood Education (ECE), where digital

integration is becoming increasingly important. Figure 1 depicts the UTAUT model as explained by Venkatesh et al. (2003).

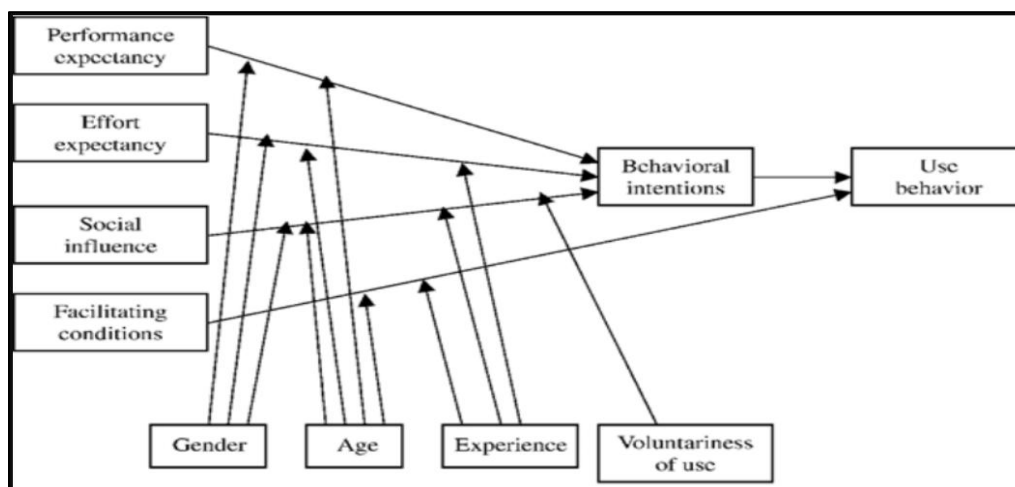


Figure 1: The UTAUT Model Source: Venkatesh et al. (2003)

According to the UTAUT, behavioural intention and actual use are determined by four main constructs: Performance Expectancy (PE), or the perceived advantages of using a technology to achieve goals; Effort Expectancy (EE), the ease of use of the technology; Social Influence (SI), the degree to which individuals believe that relevant others think they should use the technology; and Facilitating Conditions (FC), the extent to which organizational and technical infrastructure support technology use (Venkatesh et al., 2003). These constructs are particularly relevant in the context of Ghanaian ECE, where teachers' perceptions of value, usability, social pressure, and resource availability are central to the integration of DGBL.

PE: Early childhood educators' desire to use digital tools, (such as interactive whiteboards, mobile applications, has been found to be highly influenced by their perception that adopting technology will increase work performance (Xue et al., 2024). Notwithstanding their lack of digital expertise, ECE teachers are more willing to incorporate technology when they see obvious instructional or developmental benefits (Akinuwesi et al., 2022) because many early childhood educators may not have received formal ICT training. EE refers to the degree to which users perceive that using technology is easy, which is equally crucial influencing ECE teachers to adopt. User-friendly technology with low levels of complexity is more likely to be adopted in early learning environments (Joa & Magsamen-Conrad, 2022).

SI is very important in the ECE environment since instructors' readiness to use new techniques can be greatly influenced by peer collaboration, parental expectations, and administrative support. For instance, educators are more likely to use a particular digital resource if school administrators or colleagues recommend it, particularly in rural areas with limited resources (Sarosa (2019). Perhaps the most important factors in low- and middle-income settings like Ghana are FC, which include infrastructure, technical assistance, and training. Even widely acknowledged technology can be seriously hampered by inadequate access to devices, unstable electricity, and a lack of professional development opportunities (Venkatesh et al., 2003). Although UTAUT offers a sound framework for analyzing technology adoption in ECE, some scholars contend that it is insensitive to developmental and pedagogical factors specific to young students. For instance, elements like play-based learning alignment, digital well-being, and child safety are frequently outside the purview of UTAUT yet are essential in early education settings (Plowman et al., 2005). To address this gap, research has started to expand the UTAUT

model by adding concepts from student engagement models, constructivist learning theory, or contextual elements like institutional culture and instructor beliefs. Particularly in locations with limited resources, these expansions aid in adapting UTAUT to the complex requirements of ECE settings.

2.3 ECE Teachers perceptions of DGBL in the classroom

Belda-Medina's (2022) research found that pre-service educators have a good attitude toward using DGBL and perceived the approach to influence learning. Hartt et al. (2020), in their mixed-method investigation, found that teachers expect to employ DGBL in their future courses when they have a clear understanding of the approach. This contrasts with the findings of the American pre-service teachers who were in favor of DGBL but most of them were unsure of how to implement it or whether they wanted to do so (Kim et al. (2009). In a later study, Ifenthaler et al. (2012) assessed teachers' perspectives of DGBL in the classroom. It emerged that teachers thought it was very likely that DGBL would be employed for educational purposes. There were several explanations for their answers, but the most common one was the idea that the teachers thought that DGBL, an innovative methodology, is beneficial for teamwork. A further investigation by Akram et al. (2022) on technology usage by teachers revealed that the value gained was the major determinant in teachers' perceptions of adopting DGBL. The value a teacher places on a particular technological approach determines how that technology will be used. In a later study, Bal (2019) concluded that K-5 teachers used DGBL more regularly than middle school teachers in their classrooms.

However, in examining teachers' perceptions of using DGBL to raise young learners' academic performance Nikolopoulou et al. (2015) revealed that teachers were not using DGBL as often because learners required more help than usual to fully comprehend how to use some of the digital technologies. Yet, Boonmoh et al.'s (2021) study uncovered that the strongest determinant of teachers utilising DGBL was the perception of usefulness, or the capability to facilitate lessons in a simpler way in class. This could imply that, irrespective of how beneficial the approach is, teachers are unlikely to utilise this approach in classroom settings if they perceive it not to be useful. Similar results from teachers' perceptions of the biggest obstacles to utilising DGBL in the classroom were found in Falls and Thomas's (2019) investigation. The results showed that the main obstacles to integrating DGBL were: 1) lack of support for rural schools; b) cost of acquisition of hardware and software; and c) an absence of technical support, nevertheless, given the limited use of the approach in ECE, there may be additional obstacles that are unique to ECE that prevent teachers from implementing DGBL.

3. Methodology

3.1 Design

This research is a part of a broader (PhD) study conducted on designing a framework for integrating DGBL into rural ECE classrooms in Ghana. The study employs quantitative research design, with quantitative surveys to capture broad patterns into teachers lived experiences. This approach allows for a comprehensive analysis of measurable intention shaping technology adoption. The overall goal of the research reported in this study is to gain insight into ECE teachers' behavioural intention to adopt DGBL as a teaching approach in the classroom.

3.2 Participants

147 urban and rural ECE teachers were involved in the study with 78 urban and 69 rural teachers. Random sampling approach was used in selecting the teachers. Participants were automatically chosen because they were the teachers who oversaw these selected classes. The essential data about respondents are summarised in Table 1.

Table 1: Respondents' Demographic data Frequencies

Gender: Female	80	
Male	67	147
Age: 18-25	63	
26-35	68	
36-45	13	
46 and above	3	147
Highest academic qualification:		
Senior High school (SHS) certificate	35	
Teacher certificate	61	
Diploma	48	
Degree	3	
Masters	0	
Other	0	147
Location of school: Urban	79	
Rural	68	147
Working experience as teacher: Less than 1 year	27	
1-4 years	66	
5-8 years	43	
9-12 years	9	
>= 12 years	2	147

3.3 Data Analysis

A quantitative approach was used to identify trends in the data and make inferences as suggested by Saunders et al. (2009) and Oates (2006).

In this quantitative data analysis, descriptive statistics were performed to determine the competence and perceptions of teachers. SPSS and Excel were used for creating charts and interpreting data.

4. Findings and Discussion

4.1 Reliability Composite Variables for UTAUT Constructs

The data were evaluated for reliability and validity, and Table 3 provides the Cronbach Alpha for each construct and a summary of key statements and items of measurement of the constructs under UTAUT model. Table 2 provides reliability composite variables for the UTAUT constructs. The data show that all the variables are reliable. A Cronbach's alpha > 0.7 shows adequate reliability (Mishra et al., 2019).

Table 2: Reliability Composite Variables for UTAUT Constructs

Construct	Items included	Cronbach's alpha
Performance expectancy (PE)	PE1-5	.955
Effort expectancy (EE)	EE1-5	.974
Social influence (SI)	SI1-5	.974
Facilitating conditions (FC)	FC1-5	.972
Behavior Intention to adopt (BI)	BI1-5	.977

Because the data is bimodal, the usual parametric analysis was not viable. Hence, a non-parametric approach was used to analyse the data. To determine the potential effect the UTAUT constructs have on the behavioural intention to adopt the DGBL approach, Wilcoxon signed rank test was applied, and each construct score was tested against the central score of '3' (moderate). The Table below provides the Wilcoxon test statistics for the UTAUT constructs.

Performance Expectancy (PE)

Table 3 displays the frequency and the percentage distribution of the performance expectancy construct.

Table 3: Performance expectancy: Frequencies

Items of measurement	Responses as Frequency (%)					N	Z	p-value
	Very low	Low	Moderate	High	Very high			
I believe that using DGBL will positively impact my students' learning outcomes (PE1)	26 (17.7)	41 (27.9)	14 (9.5)	48 (32.7)	18 (12.2)	147	-.677	.499
DGBL is an effective method for achieving educational goals in my classroom (PE2)	26 (17.7)	41 (27.9)	15 (10.2)	44 (29.9)	21 (14.3)	147	-.492	.623
Using DGBL will lead to improvements in my students' academic performance (PE3)	31 (21.1)	33 (22.4)	11 (7.5)	39 (26.5)	33 (22.4)	147	-.480	.631
DGBL activities increase my students' engagement and motivation in the learning process (PE4)	31 (21.1)	33 (22.4)	19 (12.9)	45 (30.6)	19 (12.9)	147	-.947	.343
DGBL helps my students develop important skills such as critical thinking, problem-solving, and collaboration (PE5)	28 (19.0)	41 (27.9)	14 (9.5)	39 (26.5)	24 (16.3)	147	-.597	.550

Combining the low and very low scores and the high and very high scores across all items of measurement indicates the bimodal characteristic of the data. For instance, it can be seen that 45.6 per cent of the respondents gave a score below 3, indicating low performance expectancy (PE), while 44.9 per cent gave a score above 3, indicating high PE, for the items of measurement, "I believe that using DGBL will positively impact my students' learning outcomes" in Table 3. In a similar vein, PE2, 45.6 per cent and 44.9 per cent, indicate high and low performance expectancy. 44.9 per cent and 48.9 per cent for the item of measurement PE3, indicating low and high performance expectancy, for PE4, 43.5 per cent and 43.5 per cent indicate low performance expectancy and high performance expectancy respectively, and for PE5, 46.9 per cent and 42.8 per cent suggest low performance expectancy and high performance expectancy. None of the items is either significantly higher or significantly lower than a moderate rating of '3'. All p-values are greater than 0.1.

Effort Expectancy

Table 4 displays the percentage and frequency distribution of the EE variables.

Table 4: Effort Expectancy: Frequencies

Effort expectancy	Responses as Frequency (%)					N	Z	p-value
	Very low	Low	moderate	High	Very high			
I can easily access support when I encounter difficulties with DGBL approaches (EE1)	36 (24.5)	33 (22.4)	13 (8.8)	42 (28.6)	23 (15.6)	147	-1.174	.240
I can quickly integrate DGBL activities into my lesson plans without requiring excessive time (EE2)	36 (24.5)	30 (20.4)	9 (6.1)	41 (27.9)	31 (21.1)	147	-.142	.887
The instructions for using DGBL approaches are clear and easy to follow (EE3)	32 (21.8)	33 (22.4)	12 (8.2)	42 (28.6)	28 (19.0)	147	-.091	.928
I have the necessary technical skills to effectively use DGBL approaches in my classroom (EE4)	37 (25.2)	32 (21.8)	9 (6.1)	51 (34.7)	18 (12.2)	147	-1.444	.149

I find it easy to learn how to use DGBL approaches and technologies (EE5)	31 (21.1)	35 (23.8)	11 (7.5)	46 (31.3)	24 (16.3)	147	-.351	.726
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Regarding the items of measurement, "I can easily access support when I encounter difficulties with DGBL approaches," Table 4 shows that the low and high effort expectancy are represented by 46.9 per cent and 44.2 per cent, respectively. Likewise, for the remaining measurement items, EE2, 44.9 per cent and 49 per cent, respectively, represent low and high effort expectancy; 44.2 per cent and 47.6 per cent for the item of measurement EE3, for EE4, 47 per cent and 46.9 per cent, respectively, represent low effort expectancy and high effort expectancy; and for EE5, 44.9 per cent and 47.6 per cent, respectively, represent low effort expectancy and high effort expectancy. No item has a rating that is either noticeably higher or lower than a moderate "3." Every p-value is higher than 0.1.

Social Influence Variables

An overview of the frequency of the levels of agreement for the measurement variables is provided in Table 5.

Table 5: Social Influence: Frequencies

Social influence	Responses as Frequency (%)					N	Z	p-value
	Very low	Low	Moderate	High	Very high			
My colleagues encourage me to use DGBL in my classroom (SI1)	33 (22.4)	35 (23.8)	7 (4.8)	49 (33.3)	23 (15.6)	147	-.571	.568
The school administration assists the integration of DGBL in teaching (SI2)	29 (19.7)	35 (23.8)	16 (10.9)	59 (40.1)	8 (5.4)	147	-.1490	.136
I am influenced by my peers adopting DGBL methods in my teaching (SI3)	34 (23.1)	30 (20.4)	14 (9.5)	63 (42.9)	6 (4.1)	147	-1.916	.055
The community expects teachers to use modern teaching methods like DGBL (SI4)	28 (19)	35 (23.8)	17 (11.6)	55 (37.4)	12 (8.2)	147	-1.045	.296
Professional development programmes in my school promote the use of DGBL (SI5)	44 (29.9)	23 (15.6)	11 (7.5)	63 (42.9)	6 (4.1)	147	-2.819	.005

It can be seen from Table 5 that for the items of measurement, "My colleagues encourage me to use DGBL in my classroom," 46.2 per cent and 48.9 per cent reflect the low and high social influence respectively. Similarly for the rest of the items of measurement, SI2, 43.5 per cent and 45.5 per cent reflect the low and high social influence, respectively; 43.5 per cent and 47 per cent for the item of measurement SI3, for SI4, 42.8 per cent and 45.6 per cent indicate low social influence and high social influence, respectively; for SI5, 45.5 per cent and 47 per cent indicate low social influence and high social influence, respectively. None of the items is either significantly higher or significantly lower than a moderate rating of '3'. However, there is significant disagreement that professional development programs in the schools promote the use of DGBL, Z = -2.819, p=.005.

Facilitating Conditions Construct

Table 6 displays the items of measurement frequency and percentage distribution of the facilitating conditions construct

Table 6: Facilitating Conditions: Frequencies

Facilitating factors	Responses as Frequency (%)					N	Z	p-value
	Very low	Low	Moderate	High	Very high			

I have adequate access to the necessary technology (e.g., computers, tablets) to implement DGBL in my classroom (FC1)	29 (19.7)	37 (25.2)	14 (9.5)	60 (40.8)	7 (4.8)	147	- 1.674	.094
There is sufficient technical support available when I encounter issues with DGBL tools (FC2)	33 (22.4)	32 (21.8)	14 (9.5)	58 (39.5)	10 (6.8)	147	- 1.635	.102
I have received adequate training to effectively use DGBL in my teaching (FC3)	26 (17.7)	37 (25.2)	12 (8.2)	66 (44.9)	6 (4.1)	147	- 1.028	.304
My school provides sufficient resources (e.g., software, digital games) to support DGBL activities (FC4)	29 (19.7)	36 (24.5)	17 (11.6)	56 (38.1)	9 (6.1)	147	- 1.587	.113
The school administration supports and facilitates the use of DGBL in my classroom (FC5)	30 (20.4)	37 (25.2)	19 (12.9)	52 (35.4)	9 (6.1)	147	- 2.012	.044

It can be seen from Table 6 that for the items of measurement, “I have adequate access to the necessary technology (e.g., computers, tablets) to implement DGBL in my classroom,” 44.9 per cent and 45.6 per cent reflect the low and high facilitating conditions respectively. Similarly for the rest of the items of measurement, FC2, 44.2 per cent and 46.3 per cent reflect the low and high facilitating conditions, respectively; 42.9 per cent and 49.6 per cent for the item of measurement FC3, for FC4, 41.2 per cent and 44.2 per cent indicate low facilitating conditions and high facilitating conditions, respectively; for FC5, 45.6 per cent and 41.5 per cent indicate low facilitating conditions and high facilitating conditions, respectively. None of the items is either significantly higher or significantly lower than a moderate rating of ‘3’. However, there is significant disagreement that school administration supports and facilitates the use of DGBL in the classroom, $Z = -2.012$, $p = .044$.

Behavioural Intention

Table 7 displays the frequency and percentage distribution for the construct behavioural intention to adopt.

Table 7: Behavioural Intention: Frequencies

Behavioural Intention items of measurement	Responses as Frequency (%)					n	Z	P-value
	Very low	Low	Moderate	High	Very high			
DGBL has a positive influence on knowledge development (BI1)	41 (27.9)	26 (17.7)	1 (0.7)	45 (30.6)	33 (22.4)	147	-.187	.851
Because it is useful, I will use DGBL in the classroom (BI2)	38 (25.9)	26 (17.7)	5 (3.4)	32 (21.8)	46 (31.3)	147	- 1.035	.301
With support, I will use DGBL	26 (17.7)	38 (25.9)	3 (2.0)	33 (22.4)	47 (32.0)	147	- 2.150	.032
I have seen others use this approach successfully and therefore I will use it (BI3)	25 (17.0)	37 (25.2)	10 (6.8)	36 (24.5)	39 (26.5)	147	- 1.598	.110
Since the DGBL approach can be used to provide learners with dynamic learning opportunities, I will use it (BI4)	37 (25.2)	25 (17.0)	5 (3.4)	39 (26.5)	41 (27.9)	147	-.914	.361

Table 7 shows that 45.6 per cent and 53 per cent, respectively, represent the low/very low and high/very high behavioural intention for the measurement item, "DGBL has a positive influence on knowledge development." For the remaining items of measurement, BI2 shows low behavioural intention of 43.6 per cent and 53.1 per cent, respectively; BI3 shows low BI of 43.6 per cent and 54.4 per cent; BI4 shows low/very low behavioural intention of 42.2 per cent and 51 per cent, respectively; and BI5 shows low behavioural intention and high behavioural

intention of 42.2 per cent and 54.4 per cent, respectively. No item has a rating that is either noticeably higher or lower than a moderate "3." However, there is significant disagreement that with support the DGBL approach will be used, $Z=-2.150$, $p=0.32$.

Using the composite variables for the four constructs, the Wilcoxon test statistics was performed to determine the effect of the UTAUT constructs on the behavioural intention (BI) to use are significantly high or low. Each construct score was tested against the central score of '3' (moderate). Table 8 provides the Wilcoxon test statistics on the UTAUT constructs.

Table 8: Wilcoxon Test statistics on UTAUT Constructs

Test Statistics ^b				
	PE	EE	SI	FC
Z	-.919 ^a	-1.363 ^a	-2.011 ^a	-2.385 ^a
Asymp. Sig. (2-tailed)	.358	.173	.044	.017
a. Based on negative ranks.				
b. Wilcoxon Signed Ranks Test				

There is significant disagreement that there is social influence for the use of DGBL in the classroom, $Z = -2.011$, $p=.044$; or that, facilitating conditions are adequate to support the use of DGBL in the classroom, $Z = -2.385$, $p=.017$.

Correlation of the Demographic Variables with the UTAUT Constructs

To determine the association of the demographic variables with the UTAUT constructs, performance expectancy (PE), effort expectancy (EE), social influence, and facilitating factors, a correlation test was performed. Because the data is bimodal, perhaps because of the differing characteristics of the teachers from urban and rural settings, the Spearman's test was used. There is agreement that the UTAUT constructs are in place is significantly higher in urban than in rural communities.

Table 9: Statistics test for location: Ranks

Community Location	N		Mean Rank	Sum of Ranks
PE urban	79		106.08	8380.00
PE rural	68	147	36.74	2498.00
EE urban	79		106.92	8447.00
EE rural	68	147	35.75	2431.00
SI urban	79		106.56	8418.00
SI rural	68	147	36.18	2460.00
FC urban	79		106.29	8397.00
FC rural	68	147	36.49	2481.00

Looking at the at the “sum of ranks” we see that the value is greater for urban than rural in all cases and the means are greater for the urban teachers than the rural schoolteachers.

Gender and the UTAUT Constructs

Spearman’s correlation was performed to determine if gender is correlated with the UTAUT constructs. There was no correlation between gender and the UTAUT constructs, meaning that neither the male teachers or female teachers are more influenced by the UTAUT constructs to adopt and use the DGBL approach in the ECE classroom.

Correlation of Age and Work Experience with the UTAUT Constructs

Spearman’s correlation was again performed to determine if age and work experience are correlated with the UTAUT constructs. Table 10 indicates that age is positively correlated with performance expectancy (PE), effort expectancy (EE), and facilitating factors, while respondents’ age is negatively correlated with social influence (SI). This means that higher age groups are associated with high agreement that PE, EE, and FC impact their intention to adopt and use technology. On the other hand, higher age groups disagree that social influence impacts their behaviour and intention to adopt and use technology ($\rho = -.165, p=.045$).

Table 10: Correlation Between Age and Work Experience and UTAUT Constructs

			PE	EE	SI	FC
Spearman's rho	Age	Correlation	-	-	-	-
		Coefficient	.039	.024	.165*	.124
		Sig. (2-tailed)	.63	.772	.045	.13
		N	5			5
	Teaching experience	Correlation	.01	.016	-	-
		Coefficient	.9		.084	.066
		Sig. (2-tailed)	.81	.852	.314	.42
		N	8			5
		N	147	147	147	147

We employed non-parametric linear regression analysis to determine which independent variable(s) has the highest influence on the teachers’ intention to adopt and use DGBL in the classroom. The independent variables included the key constructs of the UTAUT theory, which are performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC). The dependent variable is the behavioural intention of ECE teachers to adopt and use DGBL in ECE classrooms in Ghana. Table 11 summarises the results of all the constructs, and the construct(s) that have the strongest influence on the behavioural intention to adopt and use DGBL in the classroom.

Table 11: Regression Coefficient Results

IV	R ²	F	df1; df2	p-value	B (regression coefficient)	t	P- value
PE	.806	147.118	4; 142	<.001	.229	2.134	.035
EE					.257	1.881	.062
SI					.674	2.982	.003
FC					-.107	-.460	.646

Dependent variable - BI

These four independent variables account for 80.6 per cent ($R^2 = .806$) of the variance in BI, $F(4, 142) = 147.118, p < .001$. Performance expectancy (PE) ($\beta = .229, p = .035$) and social influence (SI) ($\beta = .674, p = .003$) are both significant predictors of behaviour intention (BI) to adopt. Therefore, PE and SI are the two constructs that have the highest impact on the teachers' behavioural intention to adopt and use the DGBL approach. Figure 10 shows the UTAUT constructs with the highest influence on the teachers' behavioural intention to use the DGBL approach.

The findings from the UTAUT constructs indicated that performance expectancy (PE) is neither significantly higher nor significantly lower than the moderate rating of '3' across the five items of measurement. Again, from the findings, it can be said that effort expectancy (EE) is neither significantly higher nor significantly lower than the moderate rating of '3' across the five items of measurement.

5. Discussion

The current study found that all four constructs, performance expectancy, effort expectancy, social influence and facilitating conditions contribute to ECE teachers' intention to use DGBL. This accounts for 80.6 per cent of the variance. On examining the data and results closely, it is evident that the results reflect two different groups with opposite levels of agreement to UTAUT constructs. The divide is around the rural/urban location of the schools.

Looking at the mean/median values for all these constructs, the values are much higher for urban than rural school teachers. The biggest factor that influences adoption of DGBL is location. Post-hoc tests show that a considerable number of respondents in urban locations have degrees or diplomas; while a significant number of those from a rural location have SHS. So, education is correlated with location which explains why education was associated with these constructs.

For FC variables, there is significant disagreement that 'school administration supports and facilitates the use of DGBL in the classroom,' $Z = -2.012, p = .044$. The findings of the study indicated that the rural school administrators do not provide adequate support for rural ECE teachers to use technology in the classrooms. When schools' administrators do not provide the necessary support such as internet access, computers, software, and a conducive environment, teachers will find it difficult to integrate digital game-based elements into the classroom. This finding correlates with the item of measurement, 'with support I will adopt and use DGBL in the classroom,' $Z = -2.150, p = .032$. From the findings, there is neither significant agreement nor significant disagreement that teachers intend to adopt and use DGBL. The study found a statistically significant relationship between behavioural intention to use DGBL and performance expectancy (PE). This means that when teachers expect DGBL to enhance their teaching effectiveness, they are more likely to want to use it as suggested by Joa and Magsamen-Conrad (2022). Effort expectancy (EE), or how easy teachers perceive DGBL to be, was also significant. When teachers find DGBL simple and easy to use, they become more comfortable with it and are

more inclined to incorporate it into their teaching practices. This ease of use boosts their intention to integrate DGBL into their classrooms. This finding agrees with the study by Xue et al. (2024). Social influence, which refers to the impact of colleagues, administrators and parents on teachers' decisions, also plays a crucial role. The study found that positive social influence encourages teachers to adopt DGBL, as they feel supported and encouraged by their peers and the community. Facilitating conditions, which include the availability of resources and support necessary for using DGBL, were also significant. When teachers have access to the right technological resources, training and support, their confidence and intention to use DGBL increases. Overall, performance expectancy and social influence (PE and SI) were identified as the constructs with the highest influence on the teachers' behavioural intention to adopt DGBL in the classroom. ECE teachers are more inclined to use digital technologies and games in the classrooms if the approach is going to help them improve their work performance and productivity, and if colleagues and other respected individuals in society encourage them to adopt and use the approach in their classrooms, in alignment with the study by Sarosa (2019).

6. Conclusion

The study set out to explore ECE teachers' perceptions and use of DGBL underpinned by the UTAUT framework. The findings showed that PE, EE, SI and FC significantly impact the behavioural intention of ECE teachers to use DGBL in their classrooms. A teacher's behavioural intention to adopt the DGBL approach improves when they believe that DGBL can effectively perform the intended tasks. This study makes two contributions. First, it advances theoretical knowledge of technology acceptance in educational contexts by expanding the application of UTAUT to the little-studied field of early childhood education in underdeveloped nations. Second, it offers factual data on the difficulties and possibilities of DGBL integration in Ghanaian schools, emphasizing the interaction between personal beliefs and structural limitations. The study highlights the necessity of context-sensitive tactics that go beyond policy rhetoric to sustainable classroom practices by placing teacher acceptance of DGBL within Ghana's sociocultural and infrastructure realities.

6. Implications and recommendations

The issue of rural teachers' low-level competence in using digital technologies and games in classrooms is a global challenge influenced by multiple factors. The research findings serve as the foundation for several recommendations aimed at enhancing the competence of rural teachers. The study revealed that rural teachers lack the necessary support from school administration, support from the government, budget allocations, and professional development to understand how to implement DGBL into the classrooms. Rural ECE teachers believe that their chances of effectively using the DGBL approach would significantly increase if they were provided the needed support and training. Advanced digital educational games can have a substantial impact on ECE in rural areas, nonetheless, the primary challenge with emerging technology is its accessibility in rural communities. Consequently, it is recommended that rural ECE teachers be introduced to various digital technologies and games, which offer sizable benefits. Several studies on DGBL, like those of Valentová and Brečka (2023), Kaimara et al. (2022), and Bal (2019), concentrated on short-term implications and instantaneous consequences in education, leaving out long-term information on how these strategies impact learners as time passes. It is essential to investigate how DGBL can be tailored to the needs of a diverse range of learners. This includes looking into how the approach can be made more accessible and inclusive for learners of various abilities and backgrounds. As

Kucher (2021) suggested, assessing the possible advantages and drawbacks of the modern technologies is important for targeting their future adoption and use in education.

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